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ABSTRACT

Causal path analysis was used to determine the direct and indirect influences of intellectual ability, quality of instruction, achievement motivation, quantity of academic coursework, and time spent on homework on high school students' learning, as measured by their grade point averages (GPAs). Other relevant influences on grades were controlled. The theoretical models proposed were recursive path models; paths were estimated by the beta weights from multiple regression analysis. The sample population consisted of 13,152 high school sophomores selected from the base year (1980), and first (1982) and second (1984) follow-ups of the High School and Beyond Study. The subjects were high school sophomores in 1980 and high school seniors in 1982. Although only the 1980 and 1982 date were used in this study, the second follow-up data tape was used to include GPAs and coursework in the "new basics" present in student transcripts rather than simply in student self-reports. The path model included ethnicity, family background, gender, and GPA as well as the variables detailed above. Results indicate that coursework in the new basics, intellectual ability, and academic motivation were the most influential variables affecting grades. Homework had a small, but meaningful, effect. Although quality of instruction did not have a meaningful direct effect on grades, it did affect other variables in the model, such as motivation and coursework. Three data tables and two figures are included. (TJH)

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Testing Influences on Student Learning: Direct and Indirect Effects on High School Grades

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Paper presented at the annual meeting of the American Educational Research Association, San Francisco, March 29, 1989. The research reported here was conducted while the author was Senior Research Fellow, Office of Educational Research and Improvement, U.S. Department of Education. I am grateful for OERI's support and that of Virginia Tech, but the views expressed in this manuscript are mine and do not represent the official position of either organization. Correspondence should be sent to Timothy Z. Keith, 206 UCOB, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, Bitnet ID: TZKEITH at VTVM1.

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Testing Influences on School Learning: Effects on High School Grades

Continued concern about the quality of American education highlights the need to understand the important influences on students' school learning. Theories of school learning (e.g., Carroll, 1963; Walberg, 1981; Wiley & Harnischfeger, 1974), would seem to offer little help in this search because they appear to focus on different aspects of learning. Walberg, for example, discusses "educational productivity", whereas Carroll focuses on "time needed to learn" versus "time spent learning." Despite surface inconsistencies, a closer examination of these various theories reveals consistencies among them. All, for example, acknowledge the importance of intellectual ability; Carroll (1963) and Wiley (1984) include an aptitude component within the category of time needed to learn, and Walberg (1981) discusses ability as a component of aptitude.

In fact, theories of school learning generally have focused on background influences (e.g., family background characteristics and intellectual ability or aptitude), instructional variables (quality and quantity of coursework), time variables (time engaged in academic coursework, time spent on homework), and academic motivation. It is

particularly noteworthy that many of these influences are potentially manipulable; the theories therefore have implications both for changes in education in general and for specific educational interventions.

Research has also supported the importance of these and related variables in their impact on learning (cf. Keith & Cool, 1988; U.S. Department of Education, 1986; Walberg, 1986; Walberg, Schiller, & Haertel, 1979), although such support is far from consistent. Still, few researchers (with the exception of Walberg and his colleagues) have included more than one or two such influences simultaneously in their analyses so that each variable could compete with the other variables. There is considerable evidence that homework influences learning and achievement (e.g., Keith, 1982), for example, yet there is also evidence that these apparent effects may disappear when more complex analyses, incorporating additional variables, are used (e.g., Walberg & Shanahan, 1983). Even fewer researchers have focused on both the direct and indirect effects of these variables on learning, although indirect effects are quite likely. For example, motivation may have larger indirect than direct effects on student learning; highly motivated students complete more academic coursework, and this coursework, in turn, seems to affect their achievement (Keith & Cool, 1988).

Finally, most research has focused on achievement test scores as the criterion of learning; evidence of the effects of these potential influences on other measures of learning (e.g., grades) is also needed.

The purpose of the present study was to determine the extent of the direct and indirect effects of intellectual ability, quality of instruction, achievement motivation, quantity of academic coursework, and time spent on homework on high school students' learning, as measured by their grade point average. Previous research has focused primarily on achievement test scores because of their reliability and validity. This research focused on grades as the criterion because they, too, reflect an important component of learning, and because previous research has suggested that grades may be more attuned to student effort than are test scores (e.g., Fehrmann, Keith, & Reimers, 1987).

Method

Causal path analysis was used to determine the direct and indirect influences of intellectual ability, quality of instruction, achievement motivation, quantity of academic coursework, and homework on high school students' grades while controlling for other, relevant influences. The theoretical models proposed were recursive

path models; paths were estimated by the beta weights from multiple regression analysis.

Data Source

Data from a large sample of high school sophomores were analyzed. The sample consisted of 13,152 students selected from the base year (1980), first (1982), and second (1984) follow-ups of the Department of Education's High School and Beyond Longitudinal Study (HSB). The subjects were high school sophomores in 1980 and seniors in 1982. Although only 1980 and 1982 data were used in this study, the second follow-up data tape was used because it included two important variables derived from students' transcripts (rather than from self-report): high school grade point average and amount of coursework in the "new basics."

The following variables were included in the path model: ethnicity, family background, gender, intellectual ability, quality of instruction, and achievement motivation (all measured in 1980), and quantity of academic coursework (courses in the new basics), homework, and grade point average (as assessed in 1982). Following the initial analyses of the total sample, the path model was analyzed separately for different ethnic groups because previous research has suggested that different influences may be

more or less effective for different groups (Keith & Cool, 1988).

Results

Coursework in the new basics had a strong direct effect on students' high school grades (path=.267), as did intellectual ability (.255). Academic motivation also had an important direct effect (.195), and homework had a small but meaningful (defined as a path $\geq$ .05) effect (.061). Although quality of instruction did not have a meaningful direct effect on grades, it did affect other variables in the model, such as motivation and coursework. As a result, quality had a meaningful indirect effect on learning (.097); it appears that students with higher quality of instruction were more motivated and completed more coursework in the new basics. This motivation and coursework, in turn, resulted in higher grades.

Additional analyses suggested similar results for different ethnic groups within the total sample, but with some intriguing differences especially for Asian American students. For this group, coursework and homework were particularly powerful influence on grades (.298 and .296), whereas ability was a less important influence (.188).

Educational and Scientific Importance

Previous research has supported the theory-derived variables of ability, quality, motivation, academic coursework, and homework as important influences on student learning. However, few researchers have previously examined the effects of these variables in combination, looked for both direct and indirect effects, or studied their effects on outcomes other than test scores. The results of this research provide support for each of these variables as important influences on another learning outcome: high school grades. Since the variables included in this research were chosen because they are common to theories of school learning, this research also offers indirect support for the theories from which those influences were derived. In addition, many of the variables included in this research are potentially manipulable; these results therefore have implications both for changes in educational programs in general and for individual educational interventions.

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Table 1

Direct, Indirect, and Total Effects of Intellectual Ability, Quality of Instruction, Academic Motivation, Coursework in the New Basics, and Homework on High School Grades

	Effects		
Variable	Direct	Indirect	Total
Ability	.255	.157	.412
	(.016)	(.010)	(.026)
Quality	.020	.098	.118
	(.016)	(.077)	(.093)
Motivation	.195	.074	.269
	(.166)	(.063)	(.229)
New Basics	.266	.011	.277
	(.040)	(.001)	(.041)
Homework	.061	-	.061
	(.027)		(.027)

Note: Standardized coefficients are listed first; unstandardized coefficients are listed in parentheses underneath the standardized coefficients.

Table 2

Direct and Total Effects of Intellectual Ability, Quality of Instruction, Academic Motivation, Coursework in the New Basics, and Homework on High School Grades for Five Ethnic Groups

Variable	Ethnic Group (n)				
	White (7,822)	Black (1,783)	Hispanic (2,922)	Asian American (365)	Native American (243)
	Direct Effects				
Ability	.266*	.264*	.285*	.188*	.285*
	(.018)	(.017)	(.018)	(.011)	(.018)
Quality	.006	-.004	-.043*	-.081	.026
	(.004)	(-.003)	(-.032)	(-.066)	(.020)
Motivation	.231*	.092*	.140*	.152*	.137
	(.197)	(.090)	(.123)	(.170)	(.108)
New Basics	.266*	.363*	.288*	.298*	.341*
	(.039)	(.050)	(.040)	(.044)	(.054)
Homework	.044*	.043	.126*	.296*	.028
	(.020)	(.019)	(.053)	(.120)	(.011)

(table continues)

Variable	Ethnic Group				
	White	Black	Hispanic	Asian American	Native American
	Total Effects				
Ability	.435*	.425*	.430*	.273*	.344*
	(.030)	(.027)	(.028)	(.016)	(.021)
Quality	.132*	.063*	.076*	.046	.131
	(.103)	(.048)	(.057)	(.037)	(.100)
Motivation	.305*	.172*	.243*	.306*	.229*
	(.260)	(.166)	(.213)	(.343)	(.181)
New Basics	.275*	.371*	.311*	.400*	.349*
	(.040)	(.051)	(.043)	(.059)	(.055)
Homework	.044*	.043	.126*	.296*	.028
	(.020)	(.019)	(.053)	(.120)	(.011)

*$p < .05$

Note. Standardized coefficients are listed first; unstandardized coefficients are listed in parentheses underneath the standardized coefficients.

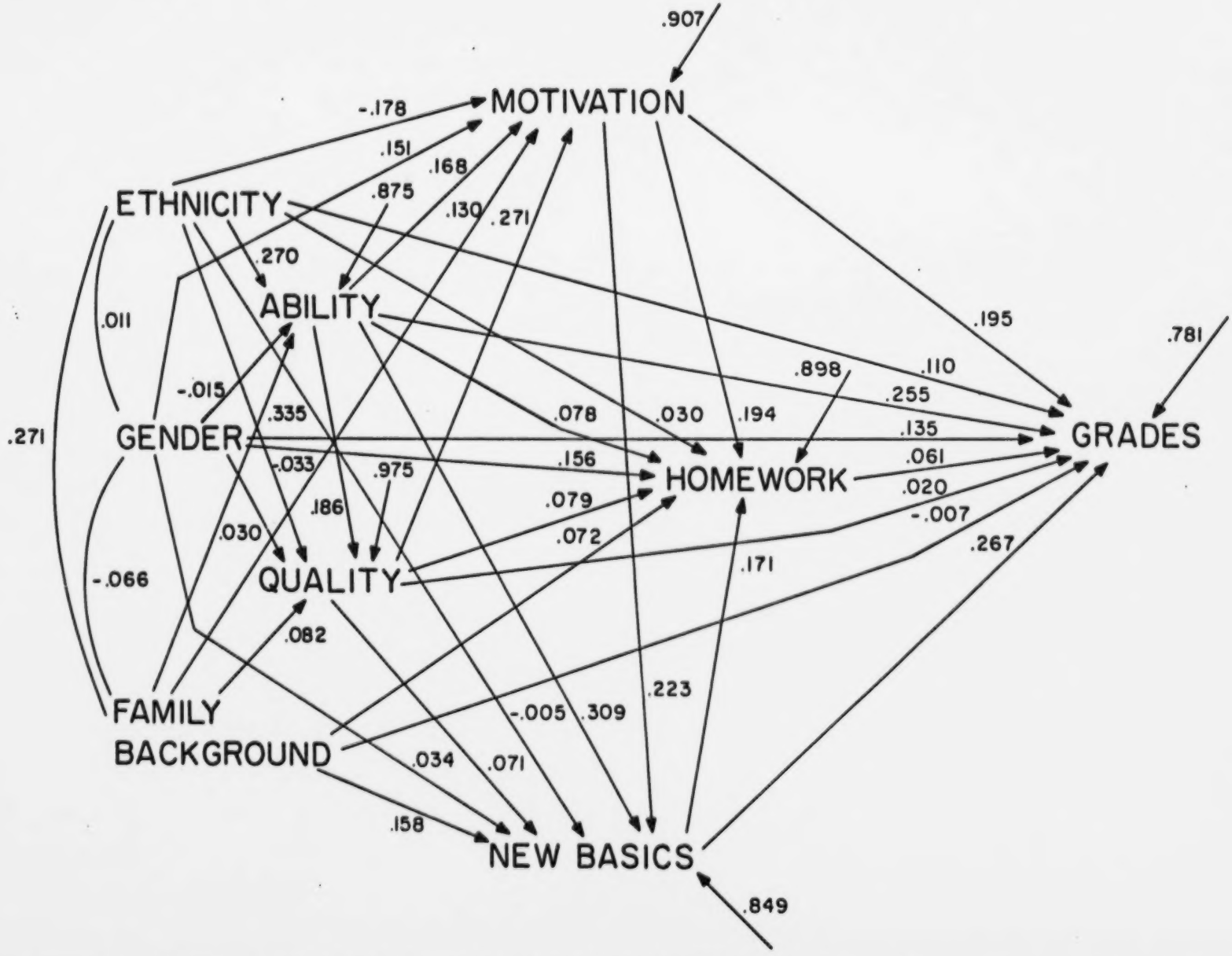

Figure 1. Effects of background variables, intellectual ability, quality of instruction, academic motivation, coursework in the new basics, and homework on high school grades.

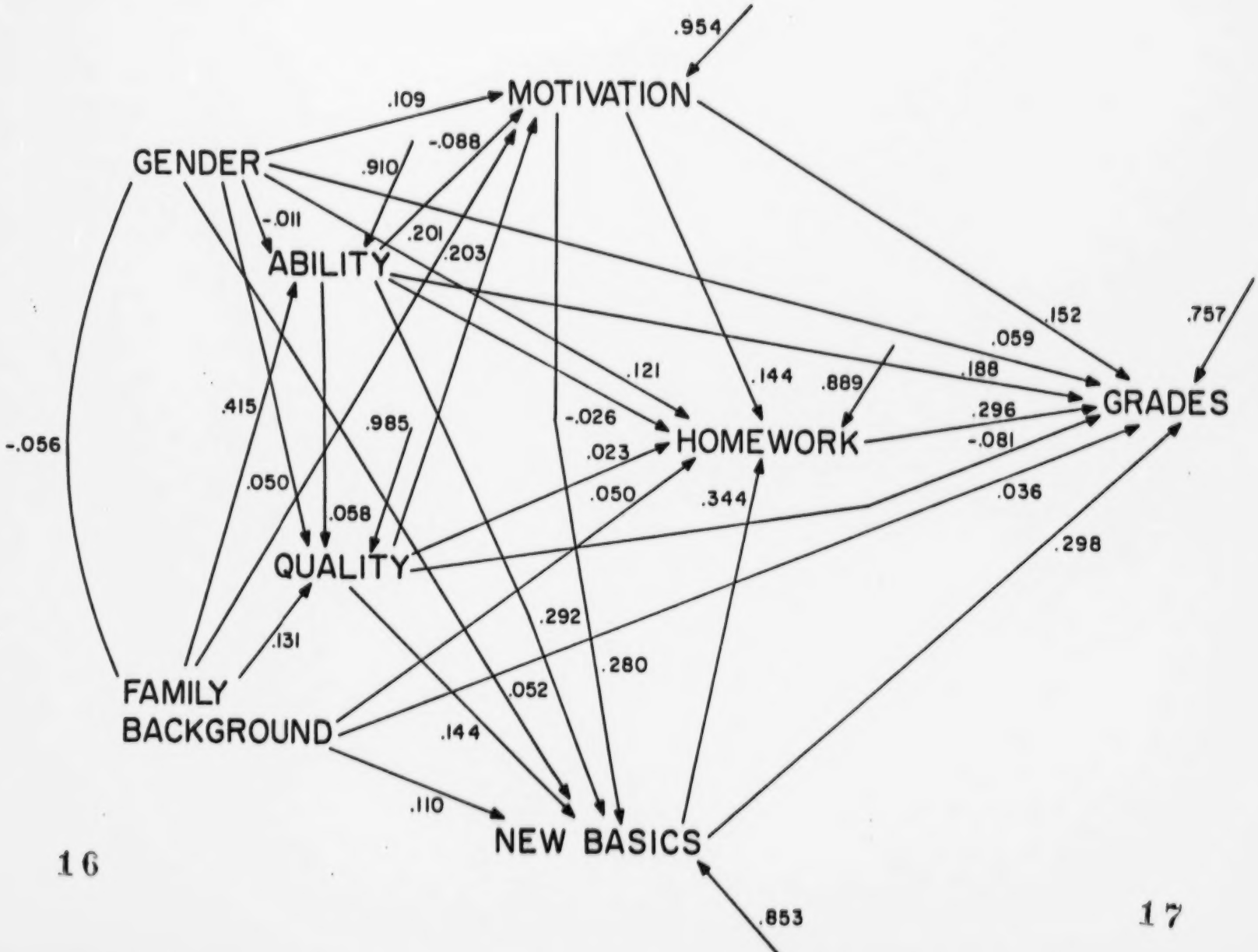

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Figure 2. Influences on high school grades for students of Asian descent.